Technical Note

All-Endoscopic Treatment of Acute Acromioclavicular Joint Dislocation: Coracoclavicular Double Cerclage EndoButton Technique and Acromioclavicular Stabilization Using the Coracoacromial Ligament

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Abstract: High-grade the acromioclavicular joint (ACJ) dislocations can be treated surgically. Endoscopic techniques to stabilize the ACJ using an EndoButton suture technique for coracoclavicular (CC) fixation have been shown to be safe and reproducible. Several studies have demonstrated the benefit of stabilizing the ACJ to reduce postoperative horizontal instability. This Technical Note presents a full-endoscopic technique for acute ACJ dislocations using a double-stranded EndoButton cerclage technique for CC reconstruction and an additional coracoacromial ligament transfer for acromioclavicular reconstruction. An autologous coracoacromial ligament transfer to the lateral clavicle increases stability in the horizontal plane and reduces the risk of anteroposterior recurrent instability. Clinical studies need to show whether additive ACJ fixation in addition to the all-endoscopic double cerclage EndoButton CC stabilization technique is in fact beneficial.

Acute acromioclavicular (AC) joint (ACJ) dislocations are common shoulder injuries, but their treatment is still controversial.[1] Although open procedures were most commonly used in the past, arthroscopic procedures recently have become much more common.[2,3] In a previous article, we described an all-endoscopic technique for acute ACJ dislocation using a coracoclavicular (CC) suture EndoButton technique in combination with AC ligament incision and resection.[4] Since various studies have demonstrated the benefit of stabilizing the ACJ to decrease postoperative horizontal instability, we are able to present an update of an all-endoscopic treatment of acute ACJ dislocations.[5,6] This technique enables the repair of the CC ligaments without creating any tunnels in the coracoid, by the means of cerclages, the dissection of the clavicle from the deltotrapezial fascia, release of the AC ligament, transfer of the coracoacromial ligament (CAL), and the reduction of the AC dislocation using an all-arthroscopic approach.

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Surgical Technique

This Technical Note builds on our previously published all-endoscopic ACJ stabilization technique.[4] The now-presented technique focuses on the additional AC capsule stabilization technique, whereas the essential surgical steps for the CC stabilization technique are presented in summary form (Video 1).

Installation

The procedure is performed with the patient under general anesthesia and in the beach-chair position. The patient's head is slightly tilted to the contralateral side to avoid problems during drilling. The surgical field is prepped and sterilely draped. The arm is placed on a traction holder.

Portals

The endoscopic portals are demonstrated in Figure 1:

- A: posterior soft point.
- D: lateral portal, under the anterolateral angle of the acromion and parallel to the upper border of the

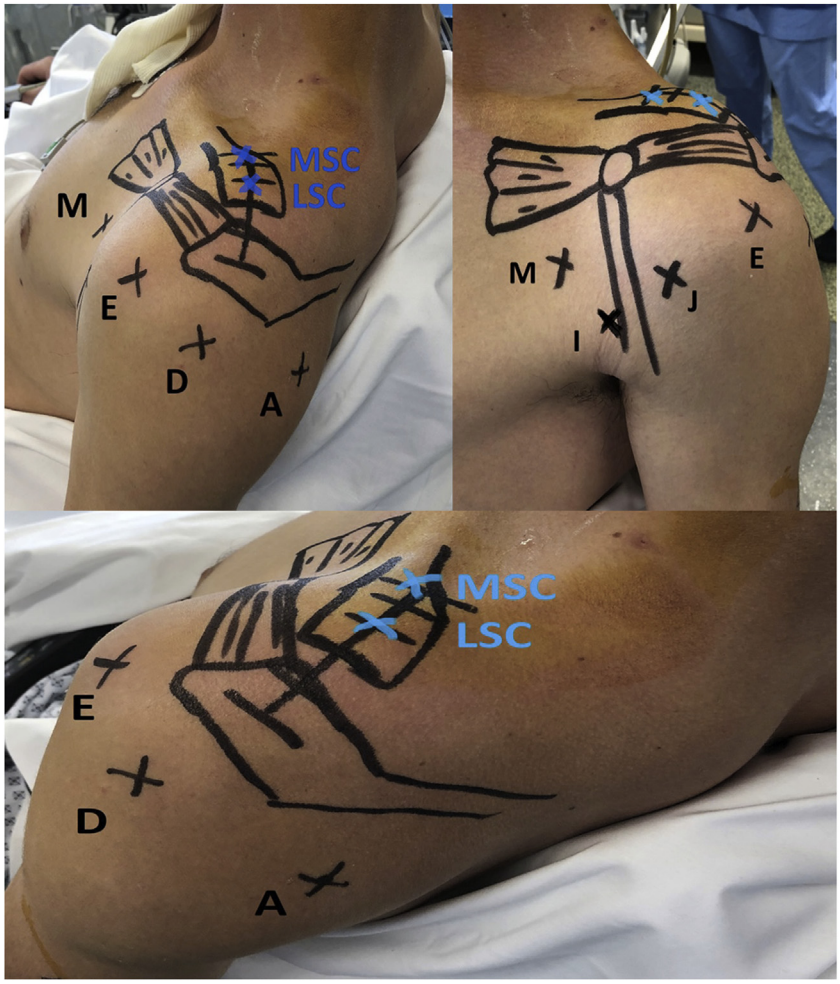

Fig 1. The patient is in the beach-chair position, and portals for all-endoscopic treatment of acromioclavicular joint dislocations are shown. View from lateral, anterolateral, and posterolateral portals on a left shoulder. (A, posterior soft point; D, lateral portal; E, anterolateral portal; I, anteroinferior portal; J, between I and E; LSC, lateral supraclavicular; M, medial approach; MSC, medial supraclavicular.) Image source: Lafosse et al.[4]

subscapularis. Also used for lateral visualization during anterior dissection.
- E: anterolateral portal through the rotator interval.
- I: inferior and anterior portal, used for anterior visualization.
- J: between I and D, used for lateral dissection and manipulation.
- M: medial portal for medial dissection and manipulation.
- LSC: lateral superior clavicle portal to drill the lateral tunnel.
- MSC: medial superior clavicle portal to drill the medial tunnel.

First Step: Glenohumeral Exploration (Viewing A Portal, Working D Portal)

Diagnostic glenohumeral arthroscopy is performed and associated intra-articular lesions (e.g., labral lesions, rotator cuff tears, long head of the biceps tendon lesions) are detected and treated (Video 1).

Second Step: Coracoid Dissection and CAL Preparation

Lateral Dissection (Viewing A Portal, Working D Portal). Opening of the rotator interval and visualizing of the base of the coracoid process is shown in Figure 2A. The CAL is identified and exposed.

Inferior and Anterior Dissection of the Coracoid (Viewing E Portal, Working I Portal). Exposition of the coracoid is completed. The conjoint tendon is dissected laterally, anteriorly, and posteriorly.

Medial Dissection (Viewing I Portal, Working M Portal). The pectoralis minor is identified, and the upper border is dissected. Medially, the musculocutaneous nerve is identified to avoid nerve damage (Fig 2B). The pectoralis minor is detached from the coracoid, and the medial border of the coracoid is exposed.

Superior Dissection (Viewing I Portal, Working M/D/E/J Portal). Exposition of the superior coracoid is performed.

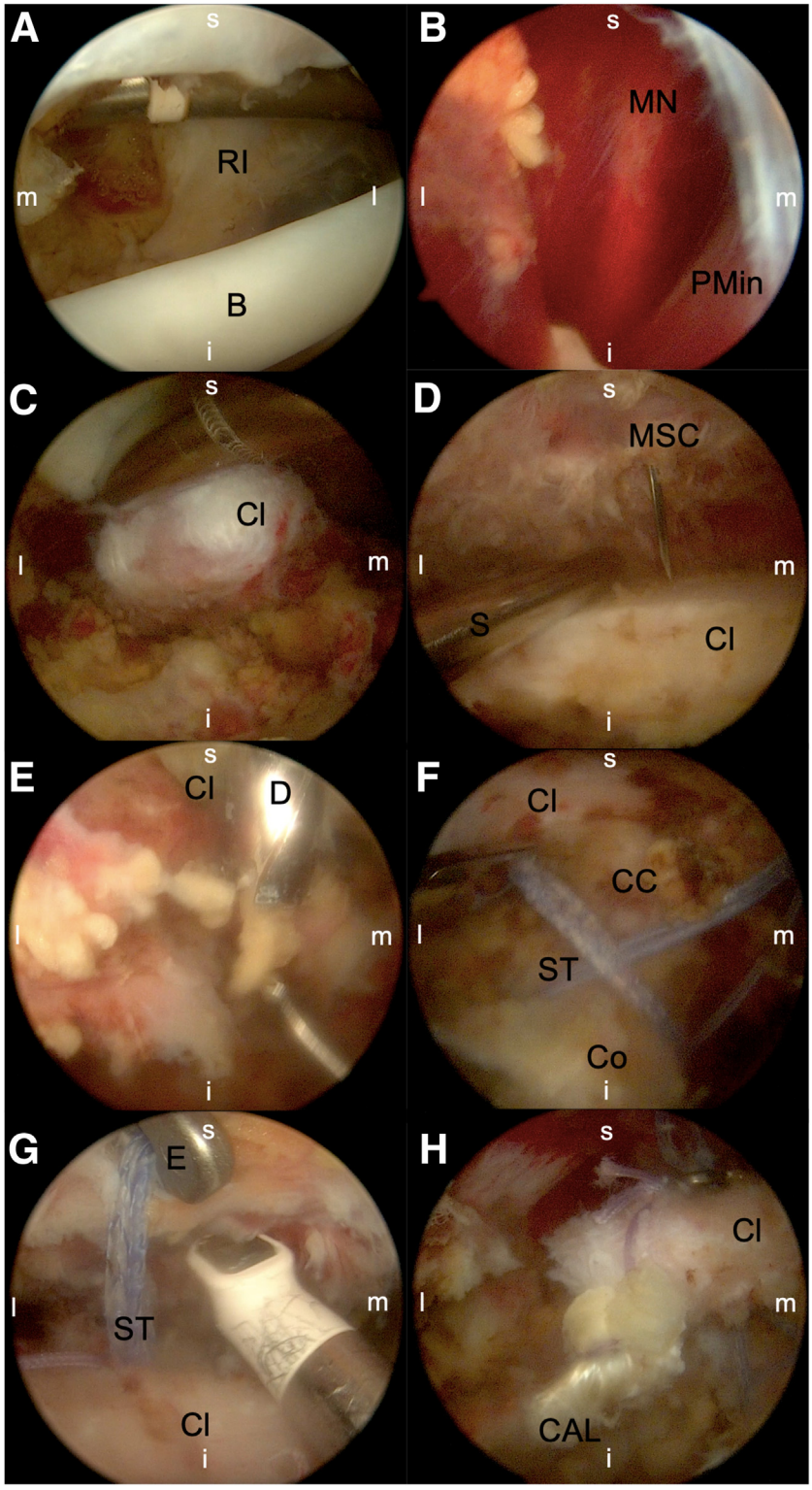

Fig 2. Surgical steps of an all-endoscopic double cerclage EndoButton technique in a patient with an acute acromioclavicular joint dislocation Rockwood type V of the right shoulder. The patient is in the beach-chair position. (A) Opening of rotator interval (viewing A portal, working D portal), (B) visualization of the MN (viewing I portal, working M portal), (C) exposition of lateral clavicula and acromioclavicular joint (viewing I portal, working M portal), (D) reduction of the clavicle and performing of the MSC portal (viewing I portal, working D portal), (E) clavicular tunnel drilling (viewing I portal, working M/MSC portal), (F) performing of both double cerclages viewing I portal, working E/LSC portal, (G) positioning of the first EndoButton (viewing I portal, working M portal), and (H) optional acromioclavicular reconstruction be transferring the CAL to the lateral EndoButton (viewing I portal). (B, long head of biceps tendon; CAL, coracoacromial ligament; CC, coracoclavicular ligaments; Cl, clavicle; Co, coracoid; D, canulated tunnel drilling device; E, EndoButton; i, inferior; l, lateral; m, medial; MN, musculocutaneous nerve; MSC, medial supraclavicular portal; Pmin, pectoralis minor muscle; RI, rotator interval; S, switching stick; s, superior; ST, suture tape).

Third Step: Clavicle Dissection/AC Dissection (Viewing I Portal, Working M/D/E/J Portal)

The inferior clavicle medial and lateral of the torn CC ligaments is exposed and dissection of the deltotrapezial fascia is performed. The upper surface of the clavicle is exposed. The deltoid can be elevated with a switching stick through the D portal. Then, switching to the working J portal, the inferior AC capsule resected to avoid interpositional tissue (Fig 2C).

Fourth Step: CAL Preparation (Viewing I Portal, Working M/D/E/J Portal)

The superior and inferior border of the CAL is debrided (Fig 3A). A single suture tape is placed posterior to the CAL (ORTHROCORD; DePuy Synthes Mitek, Raynham, MA) (working J portal). The Cleverhook (DePuy Synthes Mitek) is passed through the CAL centrally (Fig 3B) and close to the coracoid and the suture is pulled back to the first loop (working M portal). The Cleverhook is passed through the loop and the

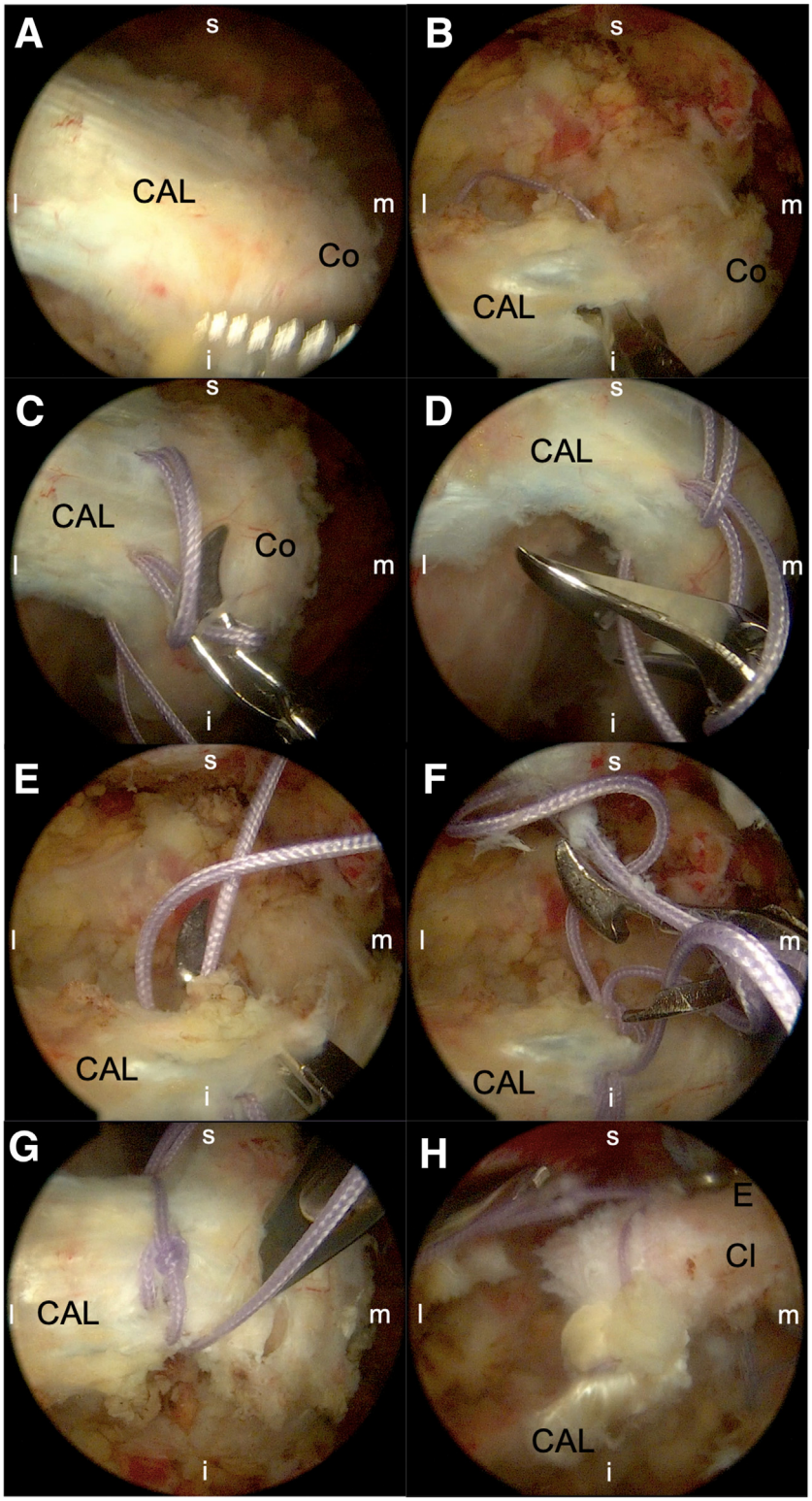

Fig 3. (A-H) Surgical steps of an all-endoscopic double cerclage EndoButton technique in a patient with an acute acromioclavicular joint dislocation Rockwood type V of the right shoulder. The patient is shown in the beach-chair position. Technical steps of an acromioclavicular joint reconstruction technique by transferring the coracoacromial ligament on the lateral clavicle are shown. (CAL, coracoacromial ligament; Cl, clavicle; Co, coracoid; E, EndoButton; i, inferior; l, lateral; m, medial; s, superior.)

CAL is perforated in the lower third (Fig 3C). The suture tape is taken from posteriorly and pulled anteriorly. One suture tape end is placed from posterior to anterior. Now the suture grasper is passed through the loop and the free suture end is grasped (Fig 3D) and pulled extracorporeally. The second suture end is placed posterosuperior. The CAL is perforated (Fig 3E), the suture is passed through the CAL, and 2 loops are created (Fig 3F). The suture end is passed through the second loop and pulled out. The CAL can now be detached from the coracoid using a scalpel (Fig 3G).

Fifth Step: Clavicle Drilling (Viewing I Portal, Working MSC Portal)

Two tunnels are performed, beginning by the medial tunnel. Under visualization, a cannula is placed to locate the position of the medial tunnel. A K-wire (2 mm) is placed in the center line of the clavicle medial to the coracoid (Fig 2D). To avoid damage to the brachial plexus while drilling with a 4-mm cannulated drill, a curette is placed inferior to the clavicle (Fig 2E). The lateral tunnel is created.

Sixth Step: CC Fixation and AC Fixation (Viewing I Portal, Working E/J/M/MSC/LSC Portal)

For the CC fixation, a suture cerclage (FiberTape Arthrex, Naples, FL) and one EndoButton (Dog Bone, Arthrex) is used for each tunnel. A suture is passed under the coracoid in a double-stranded manner to the medial side using a magic grasper (Suture Manipulator Grasper; DePuy Synthes Mitek) (working portal E). Then, the other part of the double-stranded suture is passed over the coracoid. Using a suture passer device (suture grasper 30°; DePuy Mitek Synthes) (working portal MSC), the suture tape is shuttled through the medial clavicular tunnel and pulled out of the MSC portal. Now, the lateral tunnel is created and the second doubled-stranded cerclage is performed (Fig 2F). The lateral tunnel should be placed at least 2 cm medial to the ACJ to avoid a postoperative fracture. One suture of the CAL is pulled through the lateral clavicular tunnel. The lateral EndoButton is inserted (Fig 2G). Before tightening the knot of the CAL sutures, the CC distance is reduced pushing the lateral clavicle downwards to the coracoid using a switching stick (working M portal). Under visualization, the knot of the CAL is tightened, and the suture is cut (working portal E) (Fig 3H). The lateral EndoButton is knotted and the medial EndoButton is placed and knotted in the same manner. Finally, the lateral suture bands are moved medially under the coracoid and a knot is positioned inferior to the clavicula (Fig 2H).

Discussion

Many different techniques have been described for acute ACJ dislocations. In our clinical practice, we prefer an all-endoscopic procedure because of good visualization, easily reproducible results, and a low infection rate. The presented technique ensures stabilization of the ACJ in the vertical and horizontal planes. For CC stabilization, 2 double-bundle suture cerclages around the coracoid and with 2 clavicular EndoButtons are performed. The coracoid is not drilled, which reduces the risk of coracoid fracture.[7] Thorough dissection and soft-tissue management should be performed. The musculocutaneous nerve should be exposed before tenotomy of the pectoralis minor nerve to avoid damage to the nerve. Dissection of the coracoid is required before a cerclage is placed around the coracoid. By using 2 EndoButtons positioned medial and lateral to the coracoid, the CC distance is stabilized, like the anatomy of the 2 CC ligaments. Good anatomical knowledge is essential for this technique.[8]

Since several studies have shown that additional AC fixation significantly increases the anteroposterior stability of the ACJ, many surgeons suggest an additional AC stabilization.[5,6] In this technique, the autologous CAL transfer to the lateral clavicle increases stability in the horizontal plane and reduces the risk of anteroposterior recurrent instability. Basically, various techniques for maintaining horizontal stability are described, e.g., suture anchor techniques, augmentation techniques for grafts or K-wire transfixation techniques.[5] As an alternative to the aforementioned techniques, we recommend the use of the CAL. Because of its anatomical proximity, a transposition of the coracoidal approach to the lateral clavicle appears to be extremely attractive. This achieves an AC capsular reconstruction with autologous graft, which in our view is preferable to suture-only or K-wire stabilization. The fixation of the CAL is performed with a lasso loop technique and attached to the lateral drilling hole. Finally, the CAL is positioned anteriorly. Although the AC capsule is characterized by a strong posterosuperior

Table 1. Advantages and Risks of the All-Endoscopic Coracoclavicular Double-Cerclage EndoButton Technique and Acromioclavicular Stabilization Using the Coracoacromial Ligament

Advantages
Minimal scar tissue
Illumination and magnified view
No coracoid drilling
Anatomic reconstruction of the coracoclavicular ligaments
Less knot stock irritation
Low risk of infection
Treatment of glenohumeral lesions
Risks
Greater risk for neurovascular injuries
Increased operation time
Swelling of the shoulder due to arthroscopic fluid
Theoretically increased risk of instability due to detachment of the deltotrapezial fascia

Table 2. Pearls and Pitfalls of the All-Endoscopic Coracoclavicular Double Cerclage EndoButton Technique and Acromioclavicular Stabilization Using the Coracoacromial Ligament

Pearls
Comprehensive debridement of the acromioclavicular capsule to avoid incarceration
Identify musculocutaneous nerve before tenotomy of the pectoralis minor muscle
Clipping of the small veins and arteries to minimize bleeding
Using the switching stick to lift the deltotrapezial fascia
Final knotting of the suture tapes of the medial and lateral EndoButton anteroinferior to the clavicle to avoid knot stock irritation
Pitfalls
Steep learning curve
High level of anatomical knowledge needed
Increased risk for iatrogenic nerve injuries
High risk of bleeding

bundle, studies have shown that high primary stability can also be achieved by an anterior capsular reconstruction.[9] The enclosed tables provide an overview of the advantages and risks (Table 1) as well as the pearls and pitfalls (Table 2) of the technique we have presented.

A biomechanical analysis by Theopold et al.[10] has shown no biomechanical benefit of AC reconstruction with a double tunnel coracoclavicular technique. However, it must be considered that the double-cerclage technique was not used in the biomechanical study. Whether an additional AC reconstruction has a clinicoradiologic benefit or whether it can be neglected in a double-tunnel technique must be investigated in further studies.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: M.K. reports funding grants from DePuy Synthes Mitek Sports Medicine. L.L. reports equity or stocks from DePuy Synthes. T.L. reports consulting or advisory from DePuy Synthes Mitek Sports Medicine, Stryker Orthopaedics, Smith & Nephew, and Zimmer Biomet Holdings Inc

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